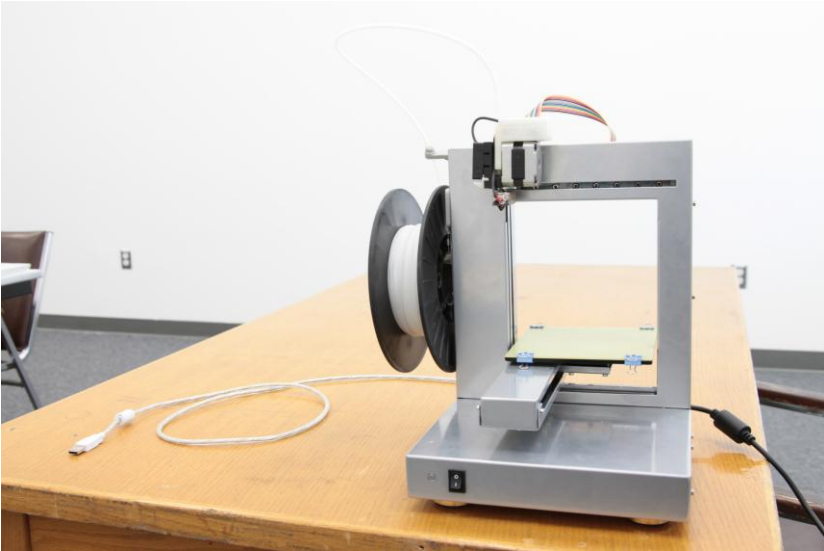


User Training Manual

UP! Desktop 3D Printer



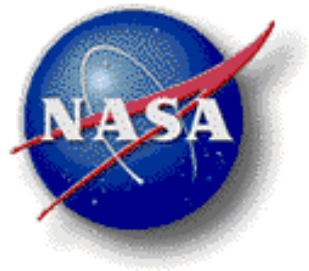
SpaceShop

Ames Research Center
Moffett Field, CA

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Rev. C

National Aeronautics and
Space Administration



ARC SPACESHOP – UP! Printer Tutorial

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SPACESHOP

UP! Desktop 3D Printer Training Manual

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C	Rev 03	12/19/2013

ARC SPACESHOP – UP! Printer Tutorial

I. Introduction

This document is for the user qualification training of the UP! Desktop 3D Printer located at the Ames SpaceShop facility on the 2nd floor in Building 220. Before a user operates the machine, he/she must have signed the required documentation as described in the “SpaceShop Standard Operating Procedures”. For additional information, please see the SpaceShop staff member.

II. UP! Desktop 3D Printer

The UP! Desktop 3D Printer is a machine that allows users to print custom-designed models using plastic (ABS or PLA). A spool of plastic, as shown in Figure 1, is attached to the side of the machine and is connected to the printer head using a tube sleeve. The printer head and nozzle then extrudes the plastic at a high temperature such that it adheres to the custom design of the model, as shown in Figure 2.

The specifications of the printer are as follows:

- Material type: ABS and PLA plastic, multiple colors, 1.75 mm diameter
- Build Platform Volume: 14 x 14 x 13.5 cm
- Layer thickness: 0.15, 0.2, 0.25, 0.3, 0.35, 0.4 mm
- Weight: 11 lb

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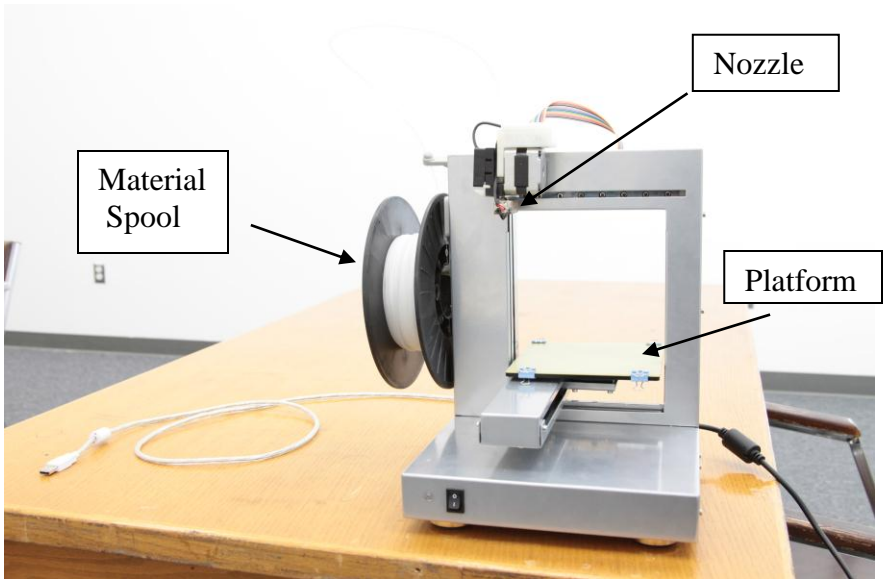


Figure 1: UP! Desktop 3D Printer

III. Safety Precautions

a. General Safety

- You **SHALL** notify SpaceShop staff prior to running any job operation.
- You **SHALL** wear closed-toe shoes at all times.
- You **SHALL** wear eye protection when working with tools and processes when working with chemicals, metal shards, wood chips or sawdust.
- You **SHALL** clean up your space after every job session, and leave 10-15 minutes for cleanup prior to shop closure.

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- You **SHALL** secure badge and any loose items that might get caught in moving machinery.
- You **SHALL NOT** leave a machine unattended while in operation.
- You **SHALL NOT** work alone while in the SpaceShop.

b. UP! Printer Safety

- You **SHALL NOT** use the machine with a damaged AC adapter, power cord, of power-plug or with a loose electrical outlet.
- You **SHALL NOT** modify the electrical power cord, nor subject it to excessive bends, twists, pulls, binding, or pinching, nor place any object of weight on it.
- You **SHALL NOT** touch the tip of the nozzle head with your fingers while printing as the nozzle is extremely hot.
- You **SHALL NOT** remove the gloves and wooden chisel from the 3D Printer station.
- You **SHALL** wear gloves when removing the part from the perf board, and use a wooden chisel to remove the part from the platform.
- You **SHALL** check to make sure there is enough plastic spool material for your

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print, and make sure it is appropriately placed in the printer head tube.

IV. Step-by-Step Tutorial

a. Tools Required

- UP! Desktop 3D Printer
- ABS or PLA plastic spool
- Computer with UP! Software
- Chisel
- Gloves
- 4 Platform Clips
- Perfboard (platform)

b. Getting Started

1. The power cord should be securely **PLUGGED** into the wall and to the back of the machine, and the USB cable should be plugged into a computer, as shown in Figure 2.

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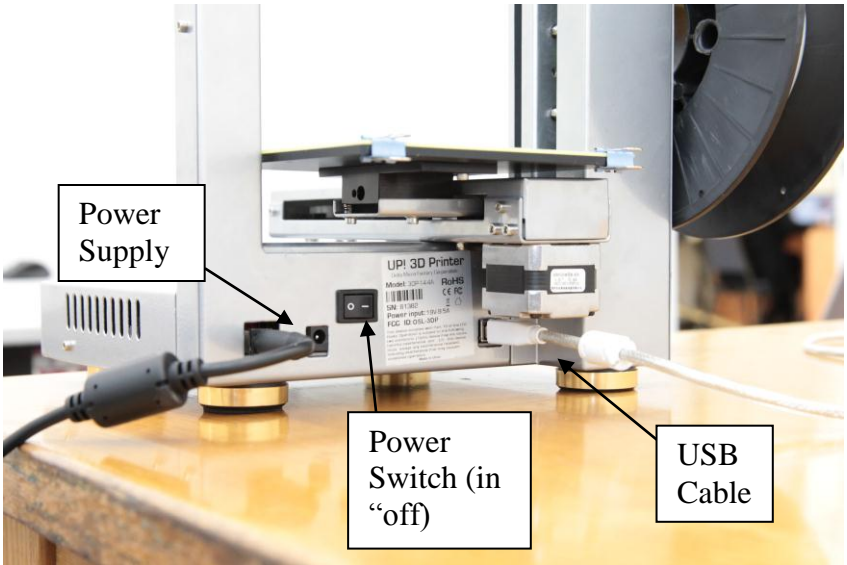


Figure 2: Back of UP! 3D Printer

2. **POWER** on the machine by turning the Power Switch to the **ON** position (see images below). When doing so, the light on the front of the machine should turn on.



Figure 3: OFF Position

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Figure 4: On Position

3. Open the UP! Printer software by locating the Software icon on the desktop of the computer and double-click to open the program. The icon is shown in Figure 5.



Figure 5: UP! Icon

4. Once the software is loaded, you should have a screen that looks like the image below.

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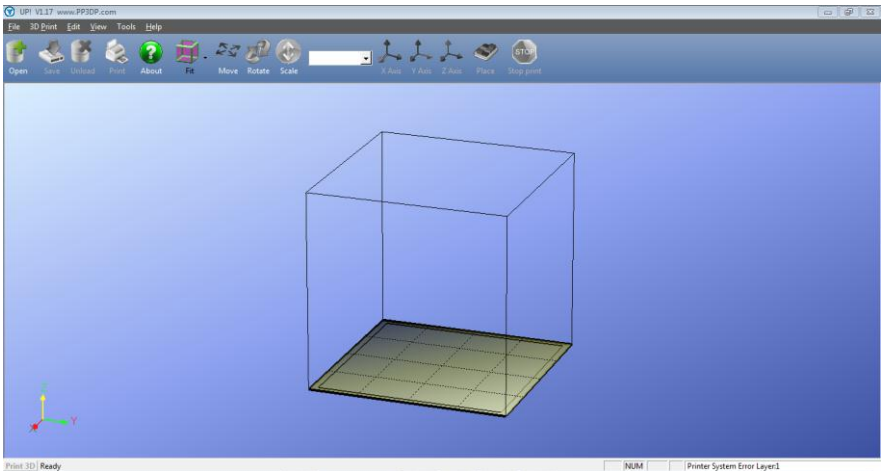


Figure 3: UP! Software

5. Before you print out any model, you must first initialize and test the machine to verify that the model will print correctly. To initialize the machine, in the menu buttons located at the top of the screen, under **3D PRINT**, click **INITIALIZE**.
6. You will **HEAR** from the machine 4 rapid **BEEP** sounds, and then you will see the platform move to a specified location (bottom-left corner if you are looking at the machine from the front), and then one last beep. The light at the front of the machine should turn green. The machine is now initialized. (You can also **INITIALIZE** the machine by holding the Off/On button, on the front of the printer, for 1 second)

*****If you have your own spool, see **Swapping Out Spool** on page 25*****

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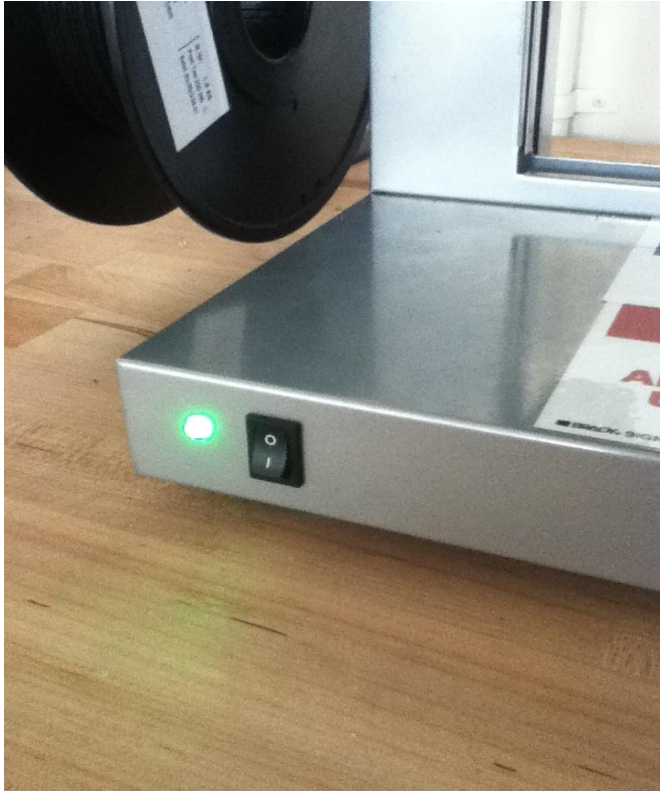


Figure 4: Initialize Button

7. Now, we must test the height of the platform to make sure we have proper adhesion to the platform for a good print. To adjust the height of the machine, under **3D PRINT**, click **MAINTENANCE**. A screen similar to the image below will appear, showing you how much material is left in the spool, the maximum height of the platform that it can go, as well as the temperatures of both the nozzle and platform.

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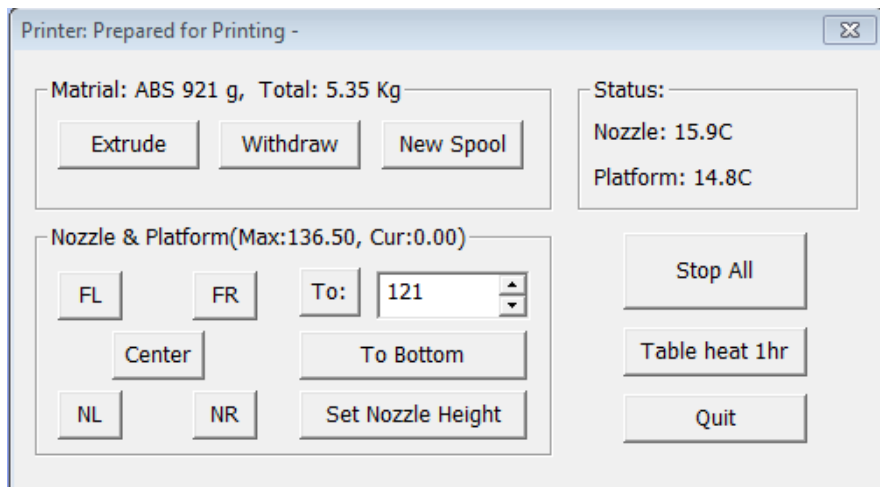


Figure 5: Maintenance Window

8. **ADJUST** height of the platform by clicking on the Up and Down arrow in the **TO:** dialog box in the **NOZZLE & PLATFORM** section.

NOTE: In Figure 5, that number is 121. To move the platform closer to the nozzle head, adjust that number to approximately 5 mm below the max platform height as a start. In Figure 5, that number will be 131.5, but it could be different depending on the current settings. Once you enter in the appropriate number, click the **TO:** button. The platform will move closer to the printer head, and the nozzle should end up approximately in the same location as shown in Figure 6 (the penny is there to give an example of how far the nozzle tip is from the platform itself).

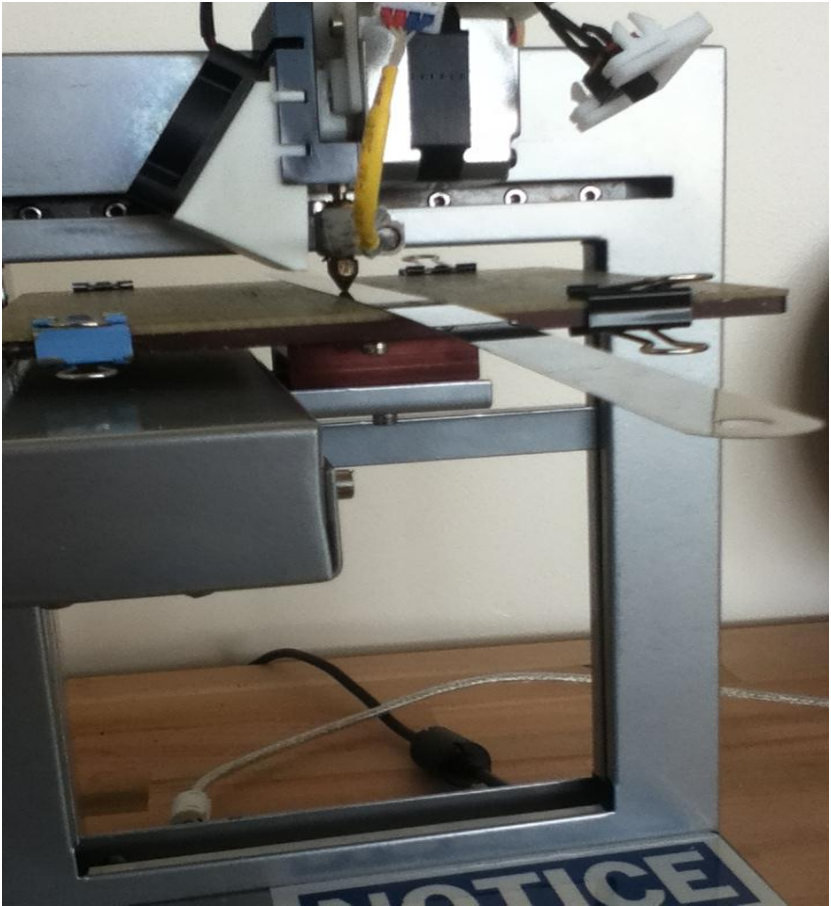


Figure 6: Printer Nozzle Height

9. The ideal distance between the nozzle tip and the platform itself should be approximately 0.2-0.8 mm. This means that the nozzle head may impact the clip located at the corner of the platform. To avoid this, in the **NOZZLE & PLATFORM** window, click the **CENTER** button. This will center the nozzle head to the platform, as shown in Figure 7.

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Figure 7: Printer Head Centered to the Platform

10. Repeat Step 7 by adjusting the height until the nozzle head is approximately 0.2-0.8 mm away (approximately between a business card thickness and a credit card thickness) from the platform.

WARNING: Do not go over the maximum height as you may impact the nozzle with the platform bed, thus damaging the equipment.

11. What will now happen is the nozzle and platform will heat up to the recommended temperatures.

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WARNING: The nozzle and platform will be VERY HOT, so please do not touch them during this process.

12. After approximately 2-3 minutes, you will hear several beeps, and then the printer will slowly extrude a test material. To test to make sure the material is at an appropriate distance, carefully peel off the material from the platform using your fingernail. If the distance is correct, the material should be hard to peel off and have extruded grooves where the material adhered to the platform.
13. If the distance is not correct based on the test material, click **NO** to the scan path message and then the nozzle head will move 0.1 mm closer to the platform. Repeat this test process until you are satisfied with the correct distance, then click “Yes” to the scan path message. Make sure that the nozzle head does not make contact with the platform as this can damage the machine.
14. Once the nozzle height is set, you can close out of the **MAINTENANCE** window. Now, you are set to print a part.
15. To load the part in the software, simply click **OPEN** on the top of the software screen, and navigate to the .STL file you wish to print. Once selected, click **OPEN**. Your part should appear inside the wire frame, as shown in the image below.

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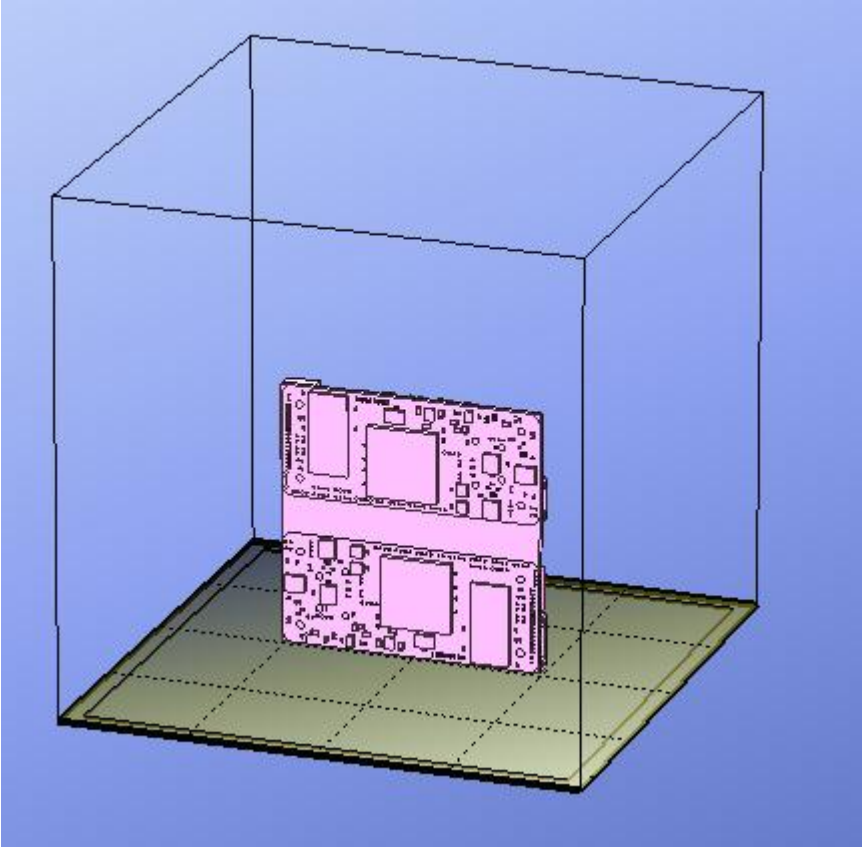


Figure 8: STL File Loaded in UP! Software

16. The software should automatically place the part inside the wire frame. If it does not, click **PLACE** on the top bar of the software.



Figure 9: Ribbon Menu Bar

17. Depending on the type of part you have, you may want to print it in a different orientation than what the software automatically provides. For example, in Figure 8, we have a tall, thin piece. You want to print this piece in the orientation shown as the thin features will be highlighted and be smooth. If instead you have a small, thick piece, you may want to print that in a horizontal orientation so that it is laying on the platform. **NOTE:** If you choose a part with a flat area more than 70 x 70 mm to print horizontally on the platform, your part may warp at the edges and thus damage your part. If you have any questions, please consult SpaceShop staff member for assistance.
18. Once your part is in the correct orientation, go to **3D PRINT → PRINT PREVIEW**. A window should open up similar to Figure 9. Notice how the **NOZZLE HEIGHT** is the same height that you set back in Step 10. Here, you can set the **QUALITY** and the **HEAT PLATFORM AFTER FINISH** option. The **QUALITY** button correlates to the speed of the print. Changing from **NORMAL** to **FAST** is about 25% faster. From **NORMAL** to **FINE**, takes about 25% slower. If you have multiple jobs, change **HEAT PLATFORM AFTER FINISH** to a desired setting. This allows the platform to remain heated for the next job once the current job finishes. Default options are set to **NORMAL** and **NO**.

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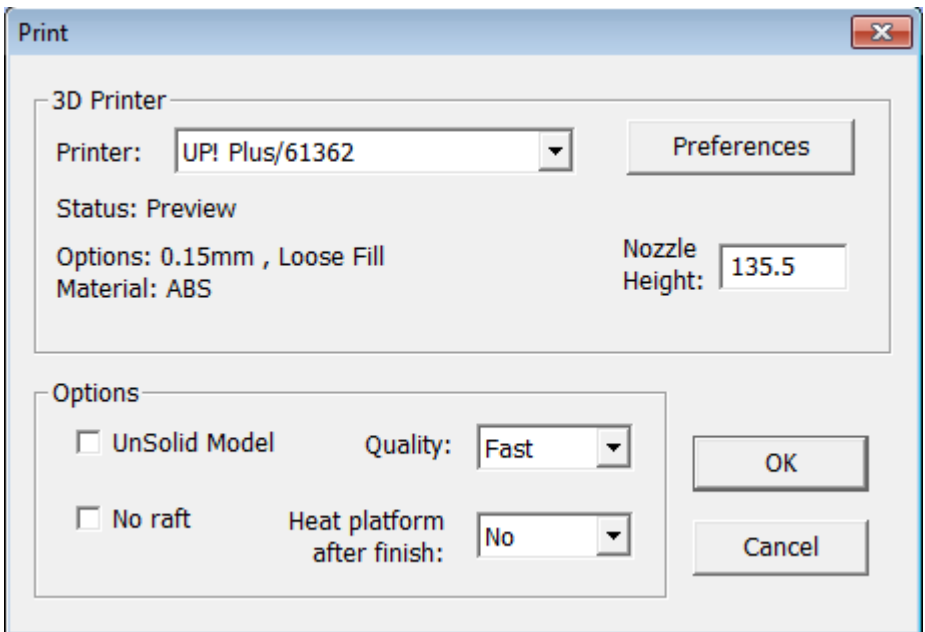


Figure 10: Print Screen

19. To check the resolution of the print job, as well as other settings pertaining to the part and support,

Z Resolution

PREFERENCES. These preferences will change the time the job will take, so please keep that in mind. Once the settings have been confirmed, click **OK.** (**Z RESOLUTION** is the distance between each layer and **FILL** refers to the density of the desired object printing. **PART** and **SUPPORT** refer to the support structures of the object printing) Unless otherwise specified, use the **RESTORE DEFAULT** button for default settings. *The default settings provide sufficient resolution and density results*

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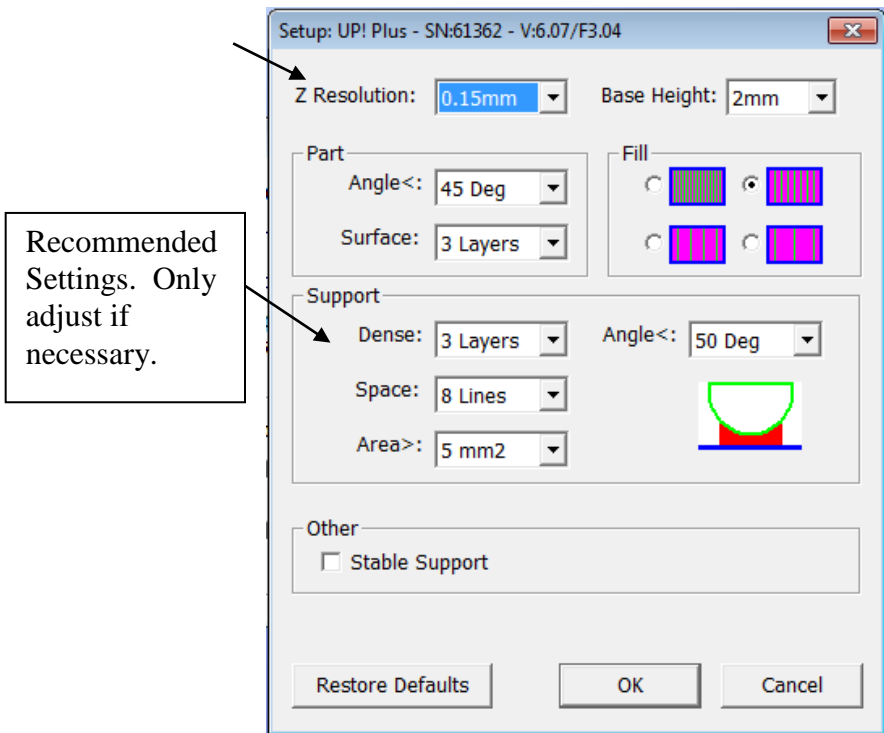


Figure 11: Print Preferences

20. Click **OK** on the **PRINT PREVIEW** window. After a few seconds, it will then tell you how much material and how long the part will take to print. Make sure that this amount is less than what the **MAINTENANCE** window mentions, or else you will run out of material during printing and **WILL NOT** be able to resume from where the print left off. Based on this information, you can go back to the **PREFERENCES** inside the **PRINT PREVIEW** box only if you want to change any of the settings. Click **OK** once you are done reviewing the information.

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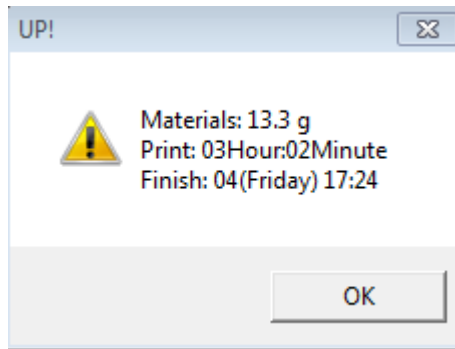


Figure 12: Print Preview Details

21. Once you have confirmed the time, the final step is to physically print the model. Go to **3D PRINT → PRINT**. A similar box that was shown in Figure 10 will appear. Now, you can click **OK** and the part will begin to print. If anything goes wrong while printing, such as the spool stops feeding or the part starts to curve at one end, click the **STOP PRINT** button on the top of the screen and remove the material and consult the SpaceShop Lead.

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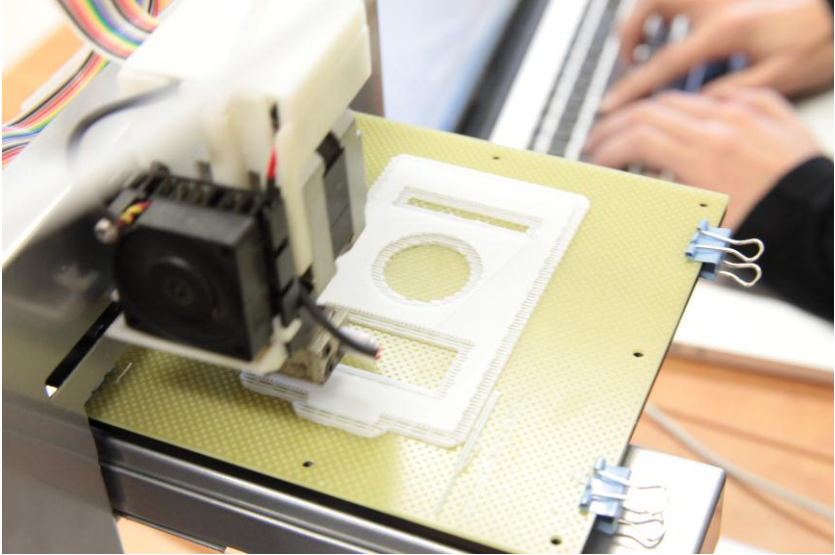


Figure 13: UP! Printer Printing Model

22. Once the print is complete, **WEAR** a pair of gloves and **UNCLIP** the platform board.
23. Use a wood chisel to remove the material from the platform displayed in Figure 14.
 - **Be careful not to point the chisel towards your body as you can get injured.**
 - **Always scrape the material off of the platform away from your body or hands.**

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- ***The hand that is not doing the scraping should be **BEHIND** the hand that is doing the scraping.***

CAUTION: Be careful when you remove the part as the platform and nozzle head are very hot.

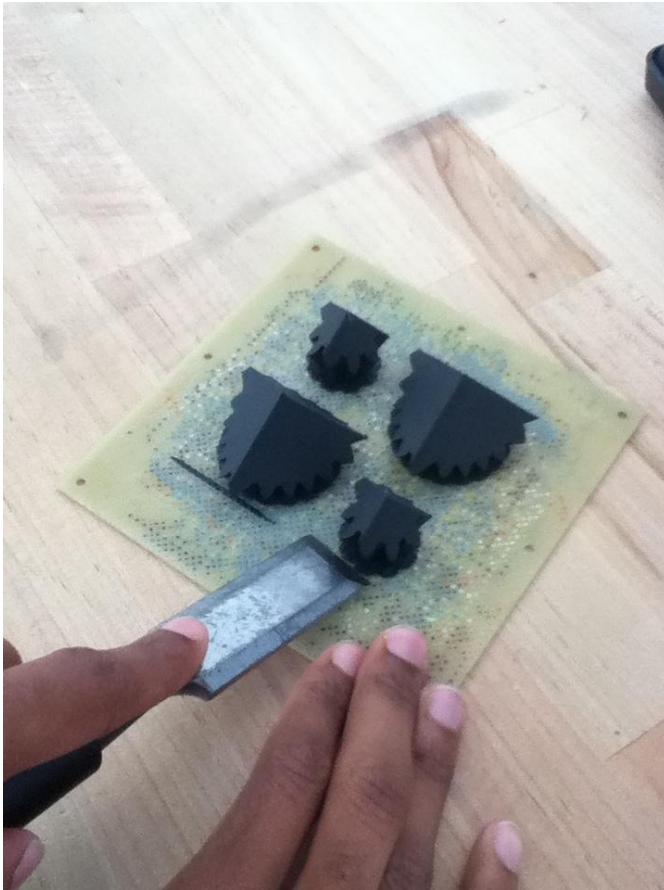


Figure 14: Correct Hand Placement and Chisel Action

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24. To remove the support material, use your hands or other hand tools and peel off the support tool carefully. Dispose of the support material in a nearby trash container.
25. Once finished, use the clips and clip the platform board back onto the machine and clean it as necessary. Do not place clip flush with the edges of the table because it can run into the sides of the 3D printer and disrupt the print.

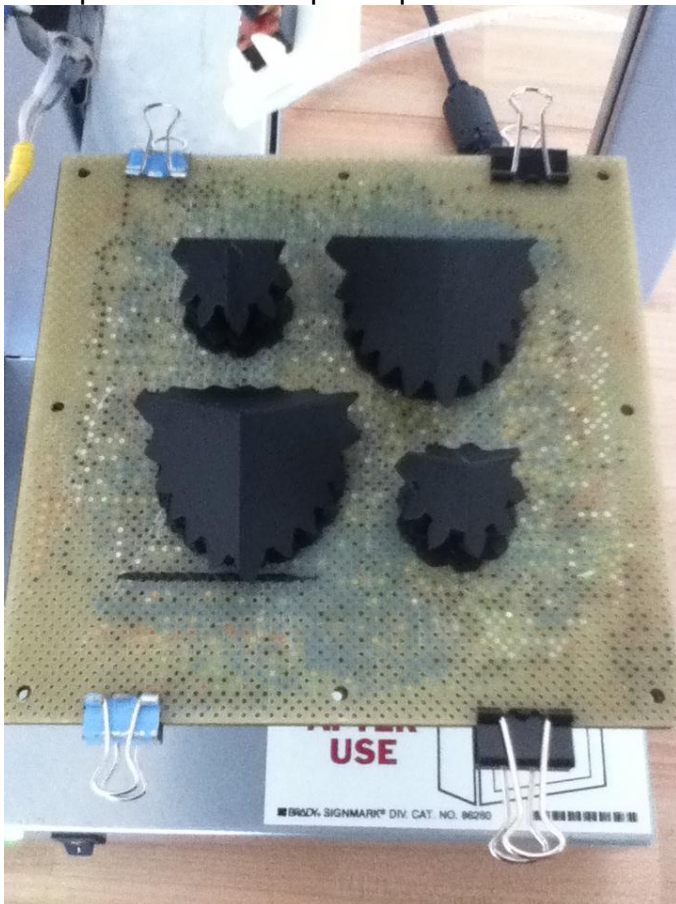


Figure 15: Placement of Clips

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26. Press and hold the front switch (next to the light) down for about 3 seconds to have the machine return back to the initial position and turn off. To turn the machine completely off, turn the Power Switch on the back to the “off” position.

27. Congratulations! You have successfully completed the UP! 3D Printer Training!

To learn more advanced techniques, such as how to print in different ways, please consult a SpaceShop staff member for more information.

Swapping Out Spools

1. To remove the filament spool, first click **MAINTENANCE** in the **3D Print** tab.

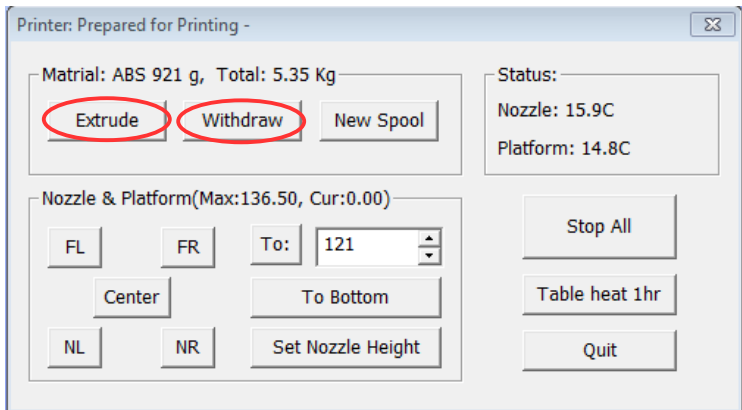


Figure 16: Maintenance Window

2. Select **WITHDRAW** and the nozzle temperature will begin to increase. Once the printer nozzle has reached its' proper temperature, it will begin to withdraw the filament (it will move in the opposite direction of the direction it feeds the material). Once withdrawn, the filament can then be removed by hand.

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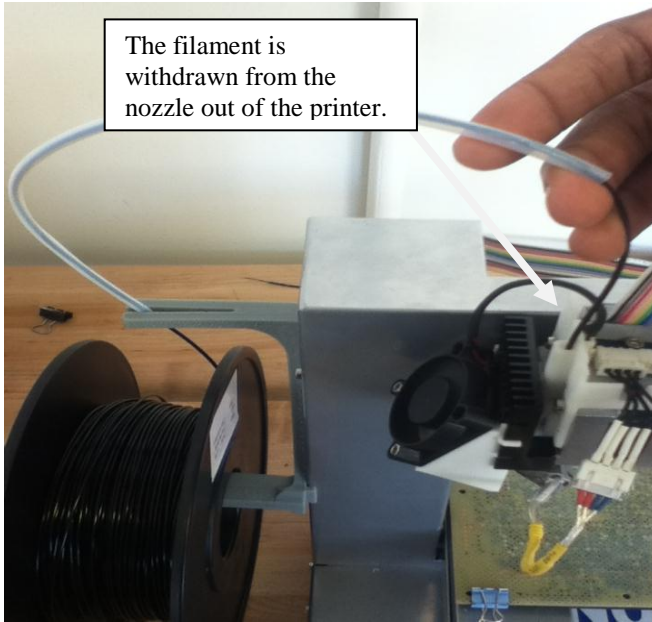


Figure 17: Filament Withdraw

3. Mount the new spool on the hanger and cut the filament at a steep angle so that it can be fed through the straw and into the printer shown in Figure 18.



Figure 18: 45 Degree Cut of Filament

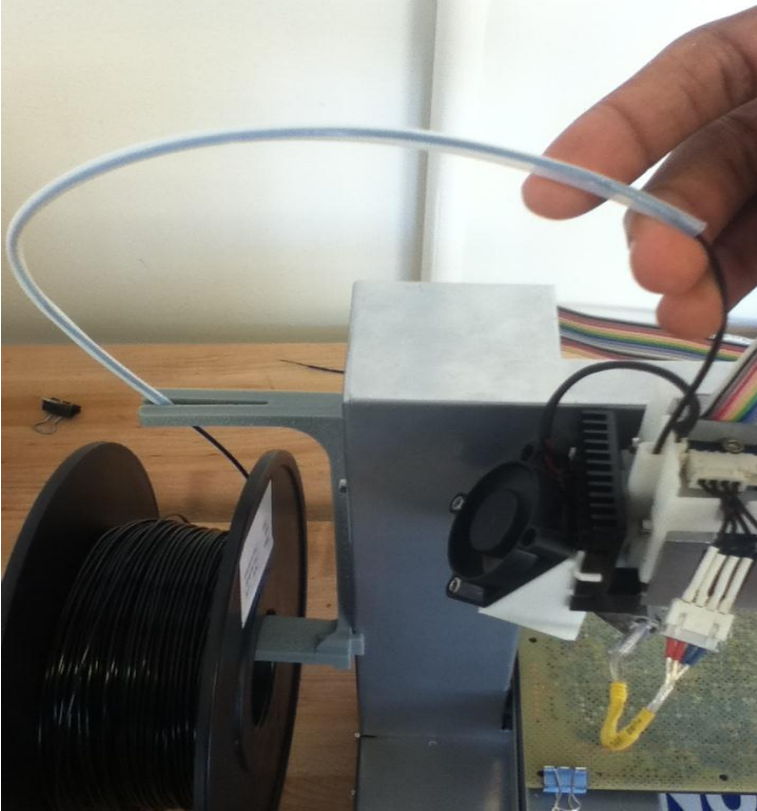


Figure 19: Spool and Straw

4. Hold the clipped end of the filament in the hole on top of the printer and select the **EXTRUDE** button. The nozzle will reheat to about 260° C and then will beep 3 times. After the beeps, the printer will pull the filament and extrude it through the nozzle.

***Filament can be purchased from Filament Supply in Mountain View or from FilamentSupply.com**